WHAT IS CLAIMED IS:

1. An implantable system, comprising:

a sensor for detecting heart sounds and for generating sensed signals representative of the heart sounds;

an interface circuit for communicating with an external system; and

a control circuit, coupled to the sensor and the interface circuit, configured to receive the sensed signals, to generate data representative of the heart sounds from the sensed signals, and to transmit the data to the external system via the interface circuit, wherein the sensor, interface circuit and control circuit are implantable.

2. The system of claim 1, wherein the sensor includes an accelerometer.

3. The system of claim 1, further comprising an implantable housing for the control circuit, wherein the sensor is located internal to the implantable housing.

4. The system of claim 1, further comprising an implantable housing for the control circuit, wherein the sensor is located external to the implantable housing.

5. The system of claim 1, wherein the interface circuit is configured to communicate with the external system using radio-frequency (RF) signals.

6. The system of claim 1, wherein the interface circuit is configured to communicate with the external system using optical signals.

7. The system of claim 1, wherein the data transmitted by the control circuit to the external system includes raw data determined by digitizing the sensed signals.

8. The system of claim 1, wherein the data transmitted by the control circuit to the external system includes processed data from processing the sensed signals.

9. An implantable system, comprising:

a first sensor for detecting heart sounds and for generating first sensed signals representative of the heart sounds;

a second sensor for detecting cardiac electrical signals and for generating second sensed signals representative of the cardiac electrical signals;

an interface circuit for communicating with an external system; and

a control circuit, coupled to the sensors and the interface circuit, configured to receive the first and second sensed signals, to generate first data representative of the heart sounds from the first sensed signals, to generate second data representative of the cardiac electrical signals from the second sensed signals, and to transmit the first data and the second data to the external system via the interface circuit, wherein the first sensor, second sensor, interface circuit and control circuit are implantable.

10. The system of claim 9, wherein the first sensor includes an accelerometer.

11. The system of claim 9, further comprising an implantable housing for the control circuit, wherein the first sensor is internal to the implantable housing.

12. The system of claim 9, further comprising an implantable housing for the control circuit, wherein the first sensor is external to the implantable housing.

13. The system of claim 9, wherein the second sensor includes an EGM sensing electrode and the second sensed signals are representative of EGM electrical signals.

14. The system of claim 9, wherein the second sensor includes an atrial sensing electrode and the second sensed signals are representative of atrial electrical signals.

15. The system of claim 9, wherein the second sensor includes a ventricular sensing electrode and the second sensed signals are representative of ventricular electrical signals.

16. The system of claim 9, wherein the second sensor is disposed in the right side of the heart.

17. The system of claim 9, wherein the second sensor is disposed in the left side of the heart.

18. The system of claim 9, wherein the first data transmitted by the control circuit to the external system includes raw data determined by digitizing the first sensed signals.

19. The system of claim 9, wherein the first data transmitted by the control circuit to the external system includes processed data from processing the first sensed signals.

20. An implantable system, comprising:

a first sensor for detecting heart sounds and for generating first sensed signals representative of the heart sounds;

a second sensor for detecting first cardiac electrical signals and for generating second sensed signals representative of the first cardiac electrical signals;

a third sensor for detecting second cardiac electrical signals and for generating third sensed signals representative of the second cardiac electrical signals;

an interface circuit for communicating with an external system; and

a control circuit, coupled to the sensors and interface circuit, configured to receive the first, second and third sensed signals, generate first data representative of the heart sounds from the first sensed signals, generate second data representative of the first cardiac electrical signals from the second sensed signals, generate third data representative of the second cardiac electrical signals from the third sensed signals, and

transmit the first, second and third data to the external system via the interface circuit, wherein the sensors, interface circuit and control circuit are implantable.

21. The system of claim 20, wherein the first sensor includes an accelerometer.

22. The system of claim 20, wherein the second sensor includes an atrial sensing electrode, and the third sensor includes a ventricular sensing electrode.

23. An external system for communicating with an implanted system configured to transmit heart sound data representative of detected heart sounds, comprising:

an interface circuit for communicating with the implanted system;

an output device for generating outputs in response to control signals; and

a control circuit, coupled to the interface circuit and the output device, configured to receive heart sound data from the implanted system, and to generate control signals which, when applied to the output device, cause the output device to generate outputs which are representative of the detected heart sounds.

24. The external system of claim 23, wherein the interface circuit is configured to communicate with the implanted system using RF signals.

25. The external system of claim 23, wherein the interface circuit is configured to communicate with the implanted system using optical signals.

26. The external system of claim 23, wherein the output device comprises a display device for generating visual outputs representative of the heart sounds.

27. The external system of claim 23, wherein the output device comprises an audio device for generating audio outputs representative of the heart sounds.

28. The external system of claim 23, wherein the generation of control signals includes applying the data representative of the heart sounds to a band-pass filter.

29. The external system of claim 28, wherein the band-pass filter has lower and upper cutoff frequencies that are set to pass frequencies indicative of heart sounds.

30. The external system of claim 28, wherein the band-pass filter has a lower cutoff frequency of about 0.05 Hz and an upper cutoff frequency of about 50 Hz.

31. The external system of claim 28, wherein the generation of control signals also includes applying an output of the band-pass filter to a rectifier.

32. The external system of claim 31, wherein the generation of control signals also includes applying an output of the rectifier to a low-pass filter.

33. The external system of claim 32, wherein the low-pass filter has a cutoff frequency of about 10 Hz.

34. The external system of claim 32, wherein the generation of control signals also includes applying an output of the low-pass filter to an ensemble averager.

35. The external system of claim 34, wherein the generation of control signals also includes using an output of a systole detector to trigger the ensemble averager.

36. The external system of claim 28, wherein the generation of control signals also includes applying an output of the band-pass filter to an ensemble averager.

37. The external system of claim 36, wherein the generation of control signals also includes using an output of a systole detector to trigger the ensemble averager.

38. The external system of claim 23, wherein the generation of control signals includes applying the data representative of the heart sounds to both first and second processing paths, the first processing path configured for machine detection of heart sounds and the second processing path configured for visual display of heart sounds.

39. The external system of claim 23, wherein the control circuit is further configured to receive surface electrocardiograph (ECG) signals, and to generate the control signals such that, when applied to the output device, the output device also generates surface ECG outputs which are representative of the surface ECG.

40. The external system of claim 39, wherein the control circuit is further configured to generate timing comparison control signals which, when applied to the output device, cause the output device to output timing comparison information indicative of relative timing between the heart sounds and surface ECG events.

41. The external system of claim 40, wherein the output device comprises a display device for generating visual outputs representative of the heart sounds, and the timing comparison control signals cause the output device to display calipers for indicating time intervals between the heart sounds and the surface ECG events.

42. The external system of claim 41, further comprising an input device, coupled to the control circuit, configured for controlling the display of the calipers.

43. An external system for communicating with an implanted system configured to transmit first data representative of detected heart sounds and second data representative of detected cardiac electrical signals to the external system, comprising:

an interface circuit for communicating with the implanted system;

an output device for generating outputs in response to control signals; and

a control circuit, coupled to the interface circuit and the output device, configured to receive first data representative of detected heart sounds and second data representative of detected cardiac electrical signals from the implanted system, and to generate control signals which, when applied to the output device, cause the output device to generate outputs representative of the detected heart sounds and cardiac electrical signals.

44. The external system of claim 43, wherein the output device comprises a display device for generating visual outputs representative of the heart sounds and the cardiac electrical signals.

45. The external system of claim 43, wherein the output device comprises an audio device for generating audio outputs representative of at least the heart sounds.

46. The external system of claim 43, wherein the cardiac electrical signals include EGM electrical signals.

47. The external system of claim 43, wherein the cardiac electrical signals include atrial electrical signals.

48. The external system of claim 43, wherein the cardiac electrical signals include ventricular electrical signals.

49. The external system of claim 43, wherein the control circuit is further configured to receive surface electrocardiograph (ECG) signals, and to generate the control signals such that, when applied to the output device, the output device also generates surface ECG outputs which are representative of the surface ECG.

50. The external system of claim 43, wherein the control circuit is further configured to generate timing comparison control signals which, when applied to the output device, cause the output device to output timing comparison information indicative of relative timing between the heart sounds and cardiac electrical signals.

51. The external system of claim 50, wherein the output device comprises a display device for generating visual outputs representative of the heart sounds and the cardiac electrical signals, and the timing comparison control signals cause the output device to display calipers for indicating time intervals between the heart sounds and the cardiac electrical signals.

52. The external system of claim 51, further comprising an input device, coupled to the control circuit, configured for controlling the display of the calipers.

53. The external system of claim 43, wherein the output device comprises a display device for generating visual outputs representative of the heart sounds and the cardiac electrical signals, with the visual outputs of the heart sounds superimposed over the visual outputs of the cardiac electrical signals to show timing therebetween.

54. The external system of claim 53, further comprising an input device, coupled to the control circuit, configured for controlling the superimposition.

55. An external system for communicating with an implanted system configured to transmit first data representative of detected heart sounds, second data representative of first cardiac electrical signals, and third data representative of second cardiac electrical signals to the external system, the external system comprising:

an interface circuit for communicating with the implanted system;

an output device for generating outputs in response to control signals; and

a control circuit, coupled to the interface circuit and the output device, configured to receive first data representative of detected heart sounds, second data representative of first cardiac electrical signals, and third data representative of second cardiac electrical signals, from the implanted system, and to generate control signals which, when applied to the output device, cause the output device to generate outputs representative of the detected heart sounds, the first cardiac electrical signals, and the second cardiac electrical signals.

56. A method of outputting heart sounds using an implanted sensor, comprising:

detecting heart sounds using a first implanted sensor; and

transmitting data representative of the heart sounds to an external system.

57. The method of claim 56, further comprising detecting first cardiac electrical signals using a second implanted sensor, and transmitting data representative of the first cardiac electrical signals to the external system.

58. The method of claim 57, further comprising detecting second cardiac electrical signals using a third implanted sensor, and transmitting data representative of the second cardiac electrical signals to the external system.

59. A method of outputting heart sounds using an implanted system, comprising:

receiving first data representative of detected heart sounds from the implanted system;

generating control signals using the first data; and

applying the control signals to an output device to cause the output device to generate outputs which are representative of the detected heart sounds.

60. The method of claim 59, further comprising receiving surface ECG data, wherein generating the control signals also includes using the surface ECG data, and

applying the control signals to the output device also causes the output device to generate surface ECG outputs which are representative of the surface ECG.

61. The method of claim 60, further comprising outputting relative timing information between the heart sounds and surface ECG events on the output device.

62. The method of claim 59, further comprising receiving second data representative of first cardiac electrical signals from the implanted system, wherein generating the control signals includes using the second data, and applying the control signals to the output device causes the output device to generate outputs which are representative of the heart sounds and the first cardiac electrical signals.

63. The method of claim 62, further comprising outputting relative timing information between the heart sounds and the first cardiac electrical signals on the output device.

64. The method of claim 62, further comprising receiving third data representative of second cardiac electrical signals from the implanted system, wherein generating the control signals includes using the third data, and applying the control signals to the output device causes the output device to generate outputs which are representative of the heart sounds, and the first and second cardiac electrical signals.

65. The method of claim 64, further comprising outputting relative timing information between the heart sounds, the first cardiac electrical signals, and the second cardiac electrical signals on the output device.

66. An external system for communicating with an implanted system, comprising:
a first interface circuit for communicating with the implanted system;
a second interface circuit for communicating with a remote system; and

a control circuit, coupled to the first and second interface circuits, configured to receive first data representative of detected heart sounds from the implanted system, and to transmit second data representative of the detected heart sounds to the remote system.

67. The system of claim 66, wherein the first and second data are the same.

68. The system of claim 66, wherein the control circuit is also configured to receive third data representative of first cardiac electrical signals from the implanted system, and to transmit fourth data representative of the first cardiac electrical signals to the remote system.

69. The system of claim 68, wherein the control circuit is also configured to receive fifth data representative of second cardiac electrical signals from the implanted system, and to transmit sixth data representative of the second cardiac electrical signals to the remote system.

70. A method of outputting heart sounds using an implanted system, comprising:

receiving first data representing detected heart sounds from the implanted system; and

transmitting second data representing the detected heart sounds to a remote system.

71. The method of claim 70, further comprising receiving third data representing first cardiac electrical signals from the implanted system, and transmitting fourth data representing the first cardiac electrical signals to the remote system.

72. The method of claim 71, further comprising receiving fifth data representing second cardiac electrical signals from the implanted system, and transmitting sixth data representing the second cardiac electrical signals to the remote system.

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